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THE UNIVERSITIES OF AUSTRALIA AND NEW ZEALAND[1]

AUSTRALIA

I SHOULD not for a moment venture to make suggestions to the authorities of the university of which I am the guest were it not that these authorities have made a special request that I should give them an outline of my impressions. Each institution must work out its own destiny in its own way and as directed by its own environment. While each university must profit by the experience of others, as the universities of America have profited enormously by the experience of the universities of Germany, no university can use the methods of another unless these methods spring naturally, from likeness in conditions.

My direct knowledge of the University of Sydney is, as you know, slight. I have met some of its professors at different times and from these I have justly formed a high estimate of the character of the institution and of its work. For the rest, I have only the university Calendar and the impressions formed in a week of cordial hospitality.

The most important matter in a university is the character of its faculty. Next comes the degree of completeness of its

[1] In a course of lectures before the University of Sydney, President Jordan was asked to give a summary of his impression of the needs of the University of Sydney. A similar request was made at Wellington regarding the four colleges which constitute the University of New Zealand.

library and appliances, and lastly, the nature and adjustments of its courses of study and the fitness of the university's methods to the actual needs of the actual people which it serves. In these regards, considered as a whole, the University of Sydney must take a very high rank. In America it would take its position in the first rank or group of American universities. In organization, methods and work, it would stand nearest to the University of Pennsylvania, and its problems are much the same as those of that institution. The faculty, although smaller than in American institutions of like grade, is of a quality equal to that of the best institutions in any country, and in this consists the main excellence of a university anywhere.

If the University of Sydney were in America, it would open its doors more widely for the admission of students. It would not lower its entrance standards, but it would allow larger freedom in choice of subjects for admission, laying less special stress on Latin, or even on languages, if the student were well prepared in other subjects requiring an equivalent amount of work. It would lay no official stress on any particular subject, but would let each stand on its merits as determined by the judgment of the masters of its preparatory schools. The university would aid the secondary schools and widen its usefulness if it would examine the schools rather than the students at the time of matriculation. In other words, it would find out from friendly conference and careful inspection which of the secondary schools of Australia really and thoroughly met its requirements. It would then receive the pupils of these schools without further question.

The university should make it possible for the energetic and competent student to pay his way by work in vacation or otherwise, without outside help, through his university course. This would involve a material reduction in fees, and the difference should be made good by the state, in view of the great advantage which would accrue to it by the extension of the public school system to its crowning element, the university. In a frontier country, the intelligence and power of the new generation arises from the cabins of the pioneers rather than from the homes of those already well-to-do.

It is the experience of America that free scholarship won in competition by the very poor or the very bright does not meet the need of the state. It is morally better that all, rich and poor, should be treated alike. Moreover, the element of competition for prizes and favors is opposed to sound scholarship and to the pursuit of learning for its own sake.

In the course of study, some modification toward the group system or the elective system will be found to intensify the interest of students in their work. Interested students make good teachers. The results of placing all subjects and all chairs on an academic equality, putting aside set courses, and placing each student's course under the direction of his major professor, have been found excellent in America. It has led to a new birth of educational interest wherever it has been tried. If each professor has the educational direction of his own students, there is no occasion for the discussion of the relative values of students and studies, as between science, mathematics, history and the classics. Each student can select his own master among the university professors and each professor can carry out his own ideas of education. After all, it is the man who counts and not the subject. There is no value in subjects prescribed for mental broadening if these are taken unwillingly.

Unwilling work forms bad mental habits, degrades learning and paralyzes instruction. In these matters the student can be trusted to choose. Whatever his choice, he can not go far wrong, and the greater the responsibility thrown on him, the more certain he is to rise to it.

The examination does not play such an all-compelling part in Sydney as in Oxford and Cambridge. And yet I think too great stress is laid upon it. What we want is that the student should do his work honestly, thoroughly, and when it is due. That he should pass an elaborate examination is another matter. The power to pass examinations well is often a matter of quick memory rather than of sound understanding. Examinations are passed through mastery of text-books; to comprehend the subject is quite another matter.

To have examinations set by outside persons is to degrade the teacher to a mere coach. To make examination a chief function of a university is to substitute an incidental function of questionable value for the real purpose of the university. The standards set by the University of London, which is primarily an examining board, are very high, but it is an open question whether this university, as an examining university granting degrees, does now anything worth while for English scholarship. The real university is a teaching university. All forms of knowledge which can broaden the mental horizon, add to the rational pleasures of life, better human conduct or be wrought into rational and helpful action are within its province.

To meet this demand in full, the range of studies in the University of Sydney will need to be greatly widened and intensified as time goes on. The number of professors should be doubled, the chairs should be subdivided, the work should be carried farther, and "the hunger and thirst which only the student knows" should be satisfied in every possible way. This again means larger equipment, a larger library and a vastly increased range of scientific appliances.

To this end the state must have a higher appreciation of the university. It must treat it more liberally—not to be generous, but to be just, toward its own interest. The rich men of Australia should regard the university as their natural heirs, for in no way can money do more good than in increasing the energy, the intelligence, the self-devotion, the efficiency of the generations which follow. That the state will demand a larger share in the control of the university is another reason why the university should educate the state.

Another need of the University of Sydney, one which can not be so easily met, is that of generous competition. The friendly rivalry between neighboring universities strengthens both, the more so if they differ in organization and method. It leads the youth of promise to feel that his choice lies between university and university, not to the mere choice between the local university and none at all.

Since California came to have two universities close together, the number of college students in the state has risen from 450 to over 4,500. The pressure of higher education to the square inch is said to be higher in California than anywhere else in the world.

On each recurrent day of athletic rivalry, the whole population of the state is divided between the blue and gold of California and the cardinal red of Stanford. In a recent address in San Francisco, Professor Bacon, of the University of California, said that if the whole endowment of Stanford had been given to the older institution, it would have helped it

less than it has been aided by the friendly rivalry of the two.

And yet, when Stanford University opened in 1891, a prominent journal said that there was "about as much need of a new university in California as for an asylum for decayed sea captains in Switzerland." It is through variation in structure and through the natural selection of favorable variations that all progress arises, whether in the evolution of organisms or in the development of universities.

The history of every nation is first written in its universities, and in so far as the Australia of the future shall have a noble career, the elements of this career must be first recorded in Sydney, in Melbourne, in Adelaide, in the universities that are and are yet to be.

NEW ZEALAND

In answer to a request for suggestions as to means of improving the teaching effectiveness of the colleges of New Zealand, I may be allowed to say:

1. Let examination be a function of the professor, not of the university. Each professor should certify to the college the work which the student has actually accomplished in satisfactory fashion.[2] Each college to certify to the university of New Zealand, through a vote of its professorial board, those students entitled to degrees.

2. Requirements of degrees should be stated in terms of work accomplished, not in terms of examinations required. The examination of any class should be controlled by its teacher.

3. The chairman of the professorial board should have as many as possible of the functions of the American university president. Especially he should have the initiative in academic matters, the choice of professors and the adjustment of courses. In this he should appear as representative of the professorial faculty, looking after their common interests and keeping in touch with them. He should frequently visit the universities of Europe and America, and in the work of teaching, should he retain his chair, he should be aided by a competent associate.

4. So far as possible, the certificate of masters of approved secondary schools should be received in place of matriculation examinations. In receiving students, a generous range of substitution of subjects should be allowed, and book-cramming, especially in science, should be discouraged.

5. In American experience, the best method of adjusting the course of study is through that form of the group system known as the "major professor" system.

In New Zealand this could be adjusted as follows:

(*a*) Each student on matriculation shall select his major work in some one of the recognized departments of the college, as classics, modern languages, English, philosophy, education, mathematics, history, economics, zoology, botany, geology, physics, chemistry, law, civil, electrical or mechanical engineering.

(*b*) The professor in charge of the department becomes the student's adviser, and his approval is necessary in all adjustments of studies at the beginning of each college term.

(*c*) Each of these departments will carry on such courses as the staff is able to

[2] At present, all papers representing final examinations in the four colleges composing the University of New Zealand (Otago College at Dunedin, Canterbury College at Christchurch, Victoria College at Wellington and University College at Auckland) are sent to London to be graded. To those successful in the final examinations in six subjects (representing about three years' work) degrees are granted by the University of New Zealand.

carry, the higher value of advanced over elementary work being kept in mind.

(*d*) To be eligible to the bachelor's degree a student must have completed the equivalent of three (preferably four) years of instruction in collegiate work. In this must be included the major work of some one department, with such minors as may be indicated by the head of such department, and also such electives as may be approved by the "major professor" at the time of registration.

(*e*) A student may change his "major department" on petition (and with the consent of the professors concerned). In this case the work done as major becomes a minor, and the back work of the new major must be made good.

(*f*) Departments should stand on a basis of academic equality, no student being obliged by the college to take one subject rather than another. Such prescription of studies should be the work of the major professor.

The colleges in New Zealand should devote themselves primarily to the actual needs of New Zealand. The professorship should carry greater power and greater responsibility than now, and much of the work of the council should be transferred to the four professorial boards.

6. Degrees should not be granted for extra-mural study, and in general not for attendance on night lectures or extension lectures.

To do work really worthy of university recognition, the student should enter the university atmosphere. He should make all possible use of teachers, laboratories and libraries.

7. Taxation of university students is the most oppressive form of state taxation.

8. In general, the professor as teacher has far too little initiative in the colleges of New Zealand. The students with their varied interests and varied talents should be the first consideration of the university. Honors may be granted on the judgment of the professorial body. It is impossible to arrange good students in linear series, as each one should be striving for a goal of his own.

DAVID STARR JORDAN
STANFORD UNIVERSITY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. SUMMER MEETING, SECTION E—GEOLOGY AND GEOGRAPHY[1]

SECTION E of the American Association for the Advancement of Science held a summer field meeting at and near Plattsburg, N. Y., July 3–11, inclusive, to which all members of the Geological Society of America and the Association of American Geographers were invited. The number in attendance at the meeting was forty-four. The section was fortunate in having delightful weather for all of the excursions, there being no rain to interfere with the field trips until noon of the last day, when the party were assembled under the hospitable roof of Professor Kemp's house on Lake George.

The preliminary trip on July 3 was made to visit "The Gulf" at Covey hill. This drive of some thirty miles from Mooers, N. Y., across the Canadian boundary was exceedingly interesting to all students of glacial geography. The marine and glacial shorelines were visited on the route westward from Mooers, and the party stopped for lunch in "The Gulf," near the two lakes which show the location of the gorge that represents the ancestor of Niagara. The noon talk, given by J. B. Woodworth, who has worked out the glacial history of this region, was on

ABANDONED SHORELINES

At "The Gulf" Professor Woodworth spoke in substance as follows: "The Gulf"

[1] Plattsburg, New York, July 3–11.

and Covey hill north of it constitute a locality of critical importance in the study of water-levels in the Champlain and St. Lawrence valleys. "The Gulf" pertains to the closing stages of the great ice-dammed lakes which formed in front of the ice in its retreat from the territory of the United States. When "The Gulf" was being excavated by a powerful torrent of water, the ice-sheet still hugged the northern side of Covey hill, itself the northernmost spur of the Adirondacks.

The waters which entered "The Gulf" came from the west, the region of Lake Iroquois, whose waters would have taken this path after the ice retreat offered a lower outlet than that at Rome. The waters passed from "The Gulf" into Lake Vermont, the preglacial lake occupying the valley of the present Lake Champlain. Lake Vermont could not at this stage of its existence have risen above the surface of the water in the waterfall pools of "The Gulf." The lower lake is now 645 feet above sea-level. The sea could not at this latitude have stood higher than the bottom of "The Gulf."

With the further retreat of the ice from the northern slope of Covey hill the water, which had previously discharged through "The Gulf" on the south side of the hill, flowed around the northern slope of the hill and emptied into the sea. The salt water came in, and the history of the great glacial lake was completed.

Signs of wave action occur on the Champlain side of the Adirondacks as high as 720 feet, but these higher water levels do not continue about the northern side of Covey hill north of "The Gulf." A good beach is continuous from the Champlain valley about Covey hill into the upper St. Lawrence valley with an altitude of 450 feet at Covey hill. Higher signs of probable wave action occur up to 570 feet, merging into beaches evidently made by torrential waters confined between the hillside and the retreating ice-front.

"The Gulf" was properly understood by Ebenezer Emmons to have been made by a powerful torrent flowing where now no stream can flow. Gilbert, with the knowledge of the glacial theory, sought for a torrent spillway along the retreating ice-sheet, and considered "The Gulf" the outlet for the glacial waters. "The Gulf" therefore is an integral part of the wonderful story of the great glacial lakes, and the political chance which has drawn the boundary line between Canada and the United States across "The Gulf" serves doubly to remind us of its living type, the gorge of Niagara.

On Thursday, July 4, those who had taken the preliminary trip to Covey hill drove from Mooers southward to West Chazy along many abandoned shorelines, at elevations varying from 300 to 600 feet above the present sea-level. At West Chazy others joined the party from Plattsburg, and all met on Cobblestone hill, where a halt was made for an hour to study the remarkable beaches of cobbles showing pronounced bars, spits and hooks, at levels of 600 feet and over above sealevel.

These beaches of heavy glacial detritus were laid down in a fresh-water glacial lake, when the ice stood a short distance north of this point, by the waters discharging from the northwest over Flat Rock from the Altona spillway.

Thence the party drove across the bare Potsdam sandstone over the Altona spillway, where striking evidences were seen of the scouring action of torrential glacial waters. After lunch at a spring of water running from the Potsdam sandstone in the spillway the party listened to a talk by H. L. Fairchild on

IROQUOIS EXTINCTION

Lake Iroquois was the great glacial water

held in the Ontario basin while the Laurentian ice-mass occupied the St. Lawrence valley and forced the overflow by the Rome outlet to the Mohawk and Hudson valleys. This original Iroquois outlet was effective for several thousand years, and determined the water-level for nearly the whole existence of the glacial waters.

When the ice-body weakened, and the front receded on the salient which projects northeastward from the Adirondacks into Canada, a lower escape for the ice-dammed waters was opened across the Covey hill ridge, precisely at the international boundary.

"The Gulf," as it is locally known, is a great cut in Potsdam sandstone, long since noted by Emmons and Gilbert, and recently described by Woodworth. The present altitude of the head of the Covey outlet is over 900 feet, but at the time it was opened the locality was about 460 feet lower than to-day, and the initiation of the river flow must have been inferior to the Rome level, which is now 440 feet.

After at least many centuries of flow this predecessor of the St. Lawrence river, carrying the overflow of the second stage of Iroquois waters (or Hypo-Iroquois), was extinguished by the ice recession opening a yet lower pass, on the north slope of Covey hill. This third phase of the Iroquois waters was short lived and of rapidly falling levels, the river-flow past the ice-front only terracing the sandstone slope.

When the waters were lowered about 450 feet below the Gulf channel, they became confluent with the oceanic waters, and the Ontario basin was occupied by the Gilbert gulf, a branch of the Champlain or Hochelogan sea.

On Friday the parties from Mooers and Plattsburg met at Chazy where Professor Cushing and Dr. Ruedemann showed the visiting geologists many interesting features of the Chazy limestone, the local succession of beds, the characteristic fossils, the faults, and the dissection which have produced the present topography. After supper, while waiting for the train to Plattsburg, the party sat on the hotel porch and listened to a talk by R. Ruedemann on

THE LOWER SILURIC PALEOGEOGRAPHY OF THE CHAMPLAIN BASIN

The relations of the faunas of the Beekmantown, Fort Cassin, Chazy, Black River, Trenton, and Utica beds to those of the Atlantic and Pacific basins and the Mississippian sea were discussed, and by means of these relations the probable marine connections of the Chazy basin and the Levis channel with the oceanic basins traced. It was suggested that the Beekmantown sea, while extending as far as the Newfoundland embayment, held an American epicontinental fauna; that the Fort Cassin fauna did not reach Canada, but flourished in the Appalachian trough to the south of the Chazy basin, and also spread westward into the epicontinental sea. The typical Chazy fauna is thus far recorded only for the Chazy basin and the southern Appalachian trough. It extended as far as the Mingan islands, and came probably from the Atlantic basin. There is also evidence that it had some connection with the American epicontinental sea.

The Black River and Trenton faunas, while largely American in their aspects, contain European species as the first of the Lower Siluric; and the connection of the Trenton sea with the Atlantic ocean can not be doubted. In Utica time the channel became so wide that an oceanic current could enter the epicontinental sea from the northwest, bringing with it new faunal elements, and spreading mud shales over a large area of eastern North America.

The evidence of a deeper sea in the

Levis channel, furnished by the series of Lower Siluric graptolite shales, was also presented, and the relations of the graptolite shales to the mobile parts of the earth-crust, the geosynclines, briefly mentioned.

Friday evening the party went to Cliff Haven, three miles south of Plattsburg, where the authorities of the Champlain Assembly had placed at the disposal of Section E the New York cottage, in which the party were delightfully housed for five days. Excursions were made each day to various points, and in the evening all returned to the broad piazzas of the cottage, where they sat and discussed the various trips, within a few feet of one of the striking fault-line scarps of the region, looking out over the waters of Lake Champlain.

On Saturday morning, July 6, the party gathered on the steam launch kindly furnished by the state of New York, and under the guidance of Professor Cushing, Dr. Ruedemann and Professor Hudson took a charming sail on Lake Champlain. The party visited Crab and Valcour islands and studied the paleozoic sediments which are there so beautifully exposed with their many interesting structural features.

At noon the party enjoyed the delightful hospitality of Professor and Mrs. George H. Hudson of Plattsburg at their charming camp on Valcour island. After lunch a paper was given by John M. Clarke on

LAKE CHAMPLAIN

Dr. Clarke spoke of the origin of the Lake Champlain valley as the result of a series of downthrown fault blocks having the evident aspect of a Graben. He referred to the later evidence as confirmatory of Logan's conception of the Lake Champlain fault and indicated that this origin was borne out by the present attitude of the downthrown paleozoic against the abrupt eastern scarps of the Adirondack crystalline shield.

Reference was also made by the speaker to the possibility that the geographical name Trembleau, which designates the prominent headland and mountain ridge just south of Port Kent, embodies the record of an ancient seismic disturbance, and with this as a text fuller reference was made to the Canadian earthquake of 1663 which appears from the records preserved in contemporary documents to be the severest disturbance this continent has ever suffered from terrestrial dislocations. This earthquake was evidently a movement of the paleozoics against the crystalline shield along the course of the St. Lawrence river or the St. Lawrence fault, and its destructive effects from Montreal down to Tadousac were tremendous. It seemed to the speaker quite reasonable to infer that this displacement must have been continued along the contact line of the paleozoics and the crystallines in the direction of the Champlain fault, although the historic records for this region are very meager.

After lunch the party divided, one portion spending the afternoon on the shores of Valcour island studying stratigraphy and paleontology. The others sailed southward to the delta of Ausable river, where a landing was made and photographs taken showing some of the recent shoreline changes. Thence this party sailed across the lake between Stave and Providence islands, and then northward along the Vermont shore, returning to Cliff Haven.

In the evening in the auditorium of the Catholic Summer School the one formal gathering of the Plattsburg meeting took place. The Reverend John Talbot Smith, LL.D., president of the summer school, welcomed the members of Section E to Cliff Haven, and said that anything they could do to make our stay pleasant and profitable would be a great pleasure to the authorities of Champlain Assembly. Father Smith introduced the vice-president

of Section E, Dr. Alfred C. Lane, who gave his vice-presidential address on the "Early Surroundings of Life."[3]

Professor B. K. Emerson thanked the authorities of the Champlain Assembly for their hospitable reception of Section E.

On Sunday various features of the local geology were visited by members of the section. Others attended services at the Chapel on the grounds.

At noon the party were entertained most delightfully by the Honorable Smith M. Weed and his family at his summer home on the shores of Lake Champlain. In the afternoon another sail was taken in a steam launch on Lake Champlain.

In the evening Professor George H. Hudson, of the Plattsburg Normal School, showed the laboratories and some of the work of his students. The members then met in the science class-room, and listened to an informal talk by Professor Hudson on "Blastoidocrinus and its Type," illustrated by fifty lantern slides. The slides of Billings's type were from negatives possessing an amplification of ten diameters, and showed in a remarkable manner many points of structure not before noted in the specimen. The outer folds of the hydrospires were seen to extend under the interbrachials to the edges of the bibrachials. The position of the stem was shown to be not normal, as Billings supposed, but thrust up into the cœlomic cavity and separating the basals from the radials. There were no features to show a specific difference between the Canadian type and the more perfect Valcour island specimen, but the type served to corroborate in a clear manner much of the detail worked out from the latter and published in Bulletin 107 of the New York State Museum.

On Monday, July 8, the party went by train from Plattsburg to Lyon Mountain, and spent the day studying the magnetite mines under the guidance of Mr. Newland. After lunch the section listened to a paper by D. H. Newland on

[3] Published in SCIENCE for August 2, pp. 129–143.

THE IRON ORES OF THE ADIRONDACK REGION

Four varieties of iron ores are found within the limits of the Adirondack region, each constituting a more or less independent class of deposits as regards geological associations and mode of origin. The varieties are as follows: (1) Non-titaniferous magnetites, (2) titaniferous magnetites, (3) hematites, (4) limonites. In respect to the relative age or period of formation, it is probable that the magnetites of class 1 are the oldest, since they antedate the metamorphism and structural disturbances that affected the region during Precambric time. The titaniferous ores were formed before the oldest of the fossiliferous rocks of the region (the Potsdam sandstone) was deposited, and are generally regarded to be contemporaneous with the igneous inclusions in which they occur. The hematite ores are probably later than the Potsdam; while the limonites have the character of bog ores and are relatively recent surface concentrations.

The non-titaniferous magnetites are the most wide-spread of all the ores in their geographical distribution, and have been in the past and still are the main source of supply for the region. In a strict sense they are hardly deserving of the name that has been applied to them by geologists, since they nearly always carry titanium, though the amount is small, usually but a fraction of one per cent. These ores are found in all parts of the Adirondacks, except the central which is occupied by the great gabbro-anorthosite mass. They are associated with different members of the Precambric crystalline series, including gneisses of igneous derivation with the

mineralogy of granites and syenites, with gneisses of doubtful relationships, and with the schists and limestones of the sedimentary (Grenville) type. Their origin is obscure, a problem that has been fruitful in discussion and theorizing among geologists. It is doubtful if any one of the explanations that have been advanced is satisfactory as a general basis for the whole group; rather it would seem that the varying conditions surrounding the character and associations of the deposits indicate that they have been formed by a complexity of processes which may have differed materially in individual cases.

The titaniferous magnetites are distinguished from those of the preceding group by their higher percentage of titanium, which ranges from about 3 or 4 per cent. as a minimum up to a maximum of 10 or 15 per cent., and by the fact that they are always enclosed by basic igneous rocks of the gabbro family. They have been described by Professor J. F. Kemp as basic segregations formed during the cooling and consolidation of the wall rocks, an explanation that is generally regarded as correct. Some of the largest deposits of iron ores in the region belong to this class, those of Lake Sanford being specially extensive. After a long period of inactivity, due to the difficulties encountered in smelting the ores in the blast furnaces, attention is now being directed to the deposits with a view to their utilization. It has been found that the ores in some cases at least are not simply magnetite carrying titanium uniformly through its mass, but that they consist of a mixture of magnetite and ilmenite, the former having almost no titanium, a condition that is favorable to their commercial treatment.

The hematite ores are practically limited to the western Adirondack region of St. Lawrence and Jefferson counties. In this area the Grenville schists and limestones attain wide development, forming an interbedded series which has been upturned and sharply folded. Granite intrusions are numerous, but there is a noticeable lack of the basic igneous rocks that occur abundantly in the central and eastern Adirondacks. The ore bodies consist of lenticular, tabular, or irregular masses enclosed within belts of the schist and limestone, or lying along the contact of these rocks as at the Caledonia mine. Stringers and larger bands of ore often extend out from the main bodies for considerable distances into the foot and hanging walls. The deposits have originated, without much doubt, by a process of replacement. They grade at the borders into the wall rock and frequently inclusions may be found that show complete transition from the rock to the ore. Where the walls are schist, the ore often preserves the appearance of banding and cleavage, and not uncommonly carries a small percentage of graphite, the only mineral that seems to have successfully resisted the solvent action of the iron-bearing solutions.

As to the source from which the iron has come, the explanation advanced by C. H. Smyth, Jr., merits full acceptance since it meets the conditions surrounding the geology of the deposits. His theory is that the iron has been derived from pyrite and magnetite, which occur abundantly in the schist in the immediate vicinity of the ore bodies. By oxidation the pyrite would yield ferrous and ferric sulphates, which would be readily taken up by the underground circulations. Free sulphuric acid would also result and react upon the veins and disseminations of magnetite. By reaction with the limestone and the minerals of the schist, the solutions would decompose and the iron precipitate as carbonate and limonite. By subsequent alteration these minerals have been changed to hematite. Residual masses of carbonate are oc-

casionally found in the deposits. Whenever the Potsdam sandstone is found in contact with the ore, the lower layers show a deep iron stain, evidently the effect of impregnation by the iron-bearing solutions.

The fourth class of iron ores, the limonites, are not of much importance in the Adirondack region. The deposits are, as already stated, superficial accumulations due to the washing and leaching of the neighboring rocks and soils. They seldom, if ever, exist of sufficient size and richness to repay working, at least under present conditions.

On Tuesday an excursion to Keesville and the Ausable chasm was made by train and tally-ho. Professors Woodworth and Cushing showed the party the marine delta of the Ausable river, the former lake shorelines, the post-Hochelogan gorge of the Ausable river cut in Potsdam sandstone, the Potsdam conglomerate, the northern slope of Trembleau mountain, and the anorthosite.

In the evening at the Champlain Club Professor H. P. Cushing discussed the evidences of physical oscillations during the Cambro-silurian in northeastern New York as brought out by a general study of the stratigraphy of the region. There was a great Potsdam subsidence on the northeast, diminishing to zero westward. The succeeding Beekmantown depression encroached further on the land than did the Potsdam on the southern margin of the region, but like that was greatest on the northeast. During the Beekmantown occurred an uplift which caused cessation of deposition in all the region except the eastern border, confining the later Beekmantown and the Chazy deposits to that district. Oscillation then occurred between the Beekmantown and the Chazy, pinching out the Chazy to the south. Depression then ensued on the south and west, and the Lowville beds were deposited. The Black River limestone followed, this being the first formation found on all three sides of the region, which indicates connecting waters and similar conditions on these sides.

In the following Trenton time it seems likely that the waters nearly overspread the entire present Adirondack region, though shoreline conditions and small subsidence are characteristic of the Mohawk valley region.

Utica shale conditions came in from the east, and gradually encroached westward on the Trenton, so that the one thickens as the other thins, the Trenton thickest on the west, the Utica on the east. Following the Utica came the uplift which brought most of the region above sea-level.

On Wednesday, July 10, the party regretfully bade good-bye to the hospitable authorities of the Catholic Summer School, and took the delightful sail down Lake Champlain.

At Baldwins, the steamboat terminal at the northern end of Lake George, the party were met by Professor J. F. Kemp, by whom they were guided in the Lake George valley. The first stop was Hague, where the graphite bed at the Lakeside mine was studied. The bed is ten feet thick, and consists of a graphitic schist in which graphite supplies the micaceous mineral. Feldspar, quartz and a little pyrite constitute the associated minerals. In physical aspect the beds appear but slightly changed from a shaly sandstone. The floor and roof rocks are a garnet-feldspar gneiss with much sillimanite. The pegmatitic phases are frequent. The several methods of origin, organic; hydrocarbons akin to petroleum; the influence of eruptive rocks, etc., were passed in review. The forms of occurrence of graphite in the Adirondacks, in crystalline limestones, pegmatite veins, and schists or quartzites

were set forth. The invariable association even of the graphite-bearing pegmatites with Grenville sediments was emphasized, and the schists seemed most probably a metamorphosed carbonaceous sediment, or one which had been impregnated with a heavy oil.

The party next visited the potholes on Indian Kettles point, two miles north of Hague. These interesting relics of the glacial epoch are on a rocky point, and fifteen feet or more above the present lake.

In the evening a brief exposition of the local geology and physiography was given by J. F. Kemp, and illustrated by manuscript maps. The sediments of the Grenville series are the oldest rocks, now greatly metamorphosed. A syenitic series of eruptives, the most extensive of the local formations, succeeded the Grenville, and these are also greatly metamorphosed. There are also rocks intermediate between syenite and gabbro; true gabbros and granites. Lastly came a few basaltic dikes. There are no late Paleozoics in the reigon, but the Potsdam and Beekmantown are near or in the Lake George basin. The physiography was believed by the speaker to be chiefly due to block faulting, which was freshened up by the ice-sculpturing of the glacial epoch.

The next morning the party proceeded to Huletts, and visited an igneous contact on Tafts point. At Huletts dock interesting pegmatites and the effects of shearing and faulting were seen. Three sets of displacement could be detected. The party were kindly taken about the lake by Dr. Smith Ely Jelliffe in his launch, adding greatly to their pleasure and profit. After lunch in the charming summer home of Professor and Mrs. Kemp the members continued south through the lake and dispersed.

The following resolutions were passed by Section E:

Section E of the American Association for the Advancement of Science in summer session assembled desires to express its high appreciation and gratitude

To Dr. John M. Clarke and the members of the New York Survey for valued advice in the preparations for this meeting, and for guidance during its progress;

To Professor and Mrs. George H. Hudson, to the Honorable Smith M. Weed, and to Professor and Mrs. J. F. Kemp for most gracious hospitality; and

To the governing board of the Champlain Assembly for giving us an attractive and convenient home during our session, and the opportunity to become acquainted with a valuable and interesting educational institution.

The following members were chosen to represent the geologists and geographers of the American Association at the centenary celebration of the Geological Society of London, to be held in September, viz:

Professor J. P. Iddings, University of Chicago, Chicago, Ill. Vice-President Section E, Geology and Geography.

Dr. John M. Clarke, State Hill, Albany, N. Y. Director Science Division, N. Y. State Education Department.

Professor R. S. Tarr, Cornell University, Ithaca, N. Y. Acting President Association of American Geographers.

F. P. Gulliver
Secretary

SCIENTIFIC BOOKS

The Birds of North and Middle America: A descriptive catalogue of the higher groups, genera, species and subspecies of birds known to occur in North America, from the Arctic lands to the Isthmus of Panama, the West Indies and other islands of the Caribbean Sea, and the Galapagos Archipelago. By Robert Ridgway, Curator, Division of Birds. Part IV., Family Turdidæ—Thrushes. Family Zeledoniidæ—Wren-Thrushes. Family Mimidæ—Mockingbirds. Family Sturnidæ — Starlings.

Family Ploceidæ—Weaver Birds. Family Alaudidæ—Larks. Family Oxyruncidæ—Sharp-bills. Family Tyrannidæ—Tyrant Flycatchers. Family Pipridæ—Manakins. Family Cotingidæ—Chatterers. Washington: Government Printing Office. 1907. Bulletin of the United States National Museum. No. 50—8vo, pp. xxii + 973, pl. i.–xxxiv.

As shown by the above transcript of the title-page, Part IV. of this monumental work includes the last six families of the Oscines and the first four families of the Mesomyodi. Two of these, the Sturnidæ and the Ploceidæ, are represented in America only by introduced species—the first by the common starling of Europe, of casual occurrence in Greenland, and introduced and apparently thoroughly naturalized over a considerable area about New York City; and the second by two weaver-finches, introduced long since from western Africa to Porto Rico, where they have become naturalized. The Alaudidæ, also almost exclusively an Old World family, is represented by only two genera, each with a single species in America, namely, *Alauda*, represented by the skylark (*Alauda arvensis*), of accidental occurrence in Greenland and the Bermudas, and also as an introduced species at various points in the United States; and *Otocoris*, comprising the horned larks, of which a single species is widely distributed in North America, reappearing in the highlands of Colombia. Other species of this genus occur in Europe and Asia, extending southward to northern Africa. The horned larks have evidently been long residents of North America, as shown by their wide distribution and multiplicity of forms, no less than twenty-five subspecies being currently recognized in America alone, and several others in northern Eurasia. This species shows great adaptability to diverse conditions of environment, it ranging from the Arctic barren-grounds to tropical northern South America, and from the most arid semi-desert areas of the southwestern United States and tableland of Mexico to the humid coast belt of Oregon, Washington, and western British Columbia. While the extreme forms are very diverse in point of size and coloration, and occupy in the breeding season remote and widely different physical areas, they are all connected by intermediate forms, occupying intermediate areas. They are all more or less migratory, and during winter several forms are often found together, but in the breeding season they occupy distinct ranges, and admirably illustrate the law that, among vertebrates at least, two closely related forms do not occupy the same area.

Of the remaining seven families treated in the present volume, one, the Turdidæ or Thrushes, is nearly cosmopolitan, while the other six are exclusively New World and mainly tropical. Two—Zeledoniidæ and Oxyruncidæ—are monotypic, the first being for the first time given family rank in the addenda (p. 885), on the basis of structural characters made known by Pycraft during the printing of the present volume. The family Zeledoniidæ is allied to the mockingbirds (Mimidæ), and Oxyruncidæ to the tyrant flycatchers. The three remaining families—Tyrannidæ, Pipridæ, Cotingidæ—are tropical American, the last two exclusively so, the first with a few genera ranging widely in temperate latitudes. The Tyrannidæ constitute one of the largest, and is the most perplexing, of the families of American birds. It contains upward of 80 genera, and more than 550 species and subspecies, which have recently been arranged by Berlepsch[1] in seven subfamilies. They present great diversity of form and habits, developing types that strongly suggest birds of widely different families, inhabiting in some cases distant parts of the globe; some resemble titmice, others kinglets, others are thrushlike, and others strongly recall pipits, wagtails and stonechats. As only thrushes, of these several diverse types, share with them the same geographic area, these resemblances can not be ascribed to protective mimicry, but must be regarded as adaptive parallelisms. Indeed, adaptive parallelism in the develop-

[1] Studien über Tyranniden, von Hans Graf Berlepsch, Proc. Fourth Internat. Orn. Congress, 1905 (1907), pp. 463–493.

ment of color patterns, relative length of wing, tail and feet, the form of the bill, etc. (the latter features often combined with conspicuous resemblances in color markings), are common, not only in birds which inhabit different continental areas, but in other classes of animals, indicating that the range of differentiation is limited, and that repetition is necessary; such repetitions have no necessary genetic relationship, being for the most part adaptive.

In the three families Tyrannidæ, Pipridæ and Cotingidæ, there are several transpositions of genera from one to the other, on the basis of newly acquired evidence respecting their affinities. There are also several important changes in nomenclature, as where *Procnias* takes the place of *Casmarinchos*, etc., and current purisms are abandoned for the original forms of names.

As in the previous volumes of this series, the treatment is strictly systematic and technical, and shows the author to be the master of his subject, while his methods are eminently worthy of emulation. With this volume his great task is half completed, and it is the wish of all systematic ornithologists that he may have the health and strength to finish in due time this vast undertaking, which easily takes rank as the most important contribution to American systematic ornithology yet undertaken.

J. A. A.

Annals of the Lowell Observatory. Volume III.: Observations of the Planet Mars during the Oppositions of 1894, 1896, 1898, 1901 and 1903 made at Flagstaff, Arizona. Percival Lowell, Director of the observatory. 1905. Pp. xiv + 293 + 60. 4to.

In the body of this book are 293 pages, with all the details of observations during the oppositions of 1894, 1896, 1900–1 and 1903 treated separately, and subdivided into eleven chapters. The first chapter under each opposition deals with general matters pertaining to methods and dates of observation. Each of the other ten chapters gives the details of the observed surface features in order of longitude from Syrtis Major back to the two Syrtes.

Nearly all the observations were made by the director himself, and are described individually and relatively in such manner as shows a symmetry of method and similarity of purpose running through work on all the four oppositions. The observations made by Mr. Douglass and Mr. Drew, while being narrated in the same methodical sequence, have been published as the supplement of sixty pages. These embody the entire report on the opposition of 1898–9, and an auxiliary report on the opposition of 1900–1.

While there are many illustrations scattered through the volume, yet the major portion is given in the appendix of twelve plates inserted between pages 266 and 267, under the title: "1903 Drawings of Mars, being selected reproductions direct from the record-book Views from the Globe made from Observations of the Opposition"—whatever that may mean. Following these plates, pages 267–281, is a complete "Index of Names on Maps and Globes of Mars" inclusive of an index to volumes one and two of the *Annals*.

"Of the making of books, there is no end" is a dictum of about twenty centuries ago, and a thousandfold more true since the advent of printing than then. That this book is a handsome example of the "art preservative" no one can deny: large type, leaded; extra wide margins, with marginal headings; typography for the most part even, and press-work superb: the paper, heavy plate. It is a pleasure to read such books, whatever be their contents. It is all the greater pleasure when one finds such a piquancy of style, and such a wealth of detail of observation coupled with such explicitness of statement through so many pages, concerning objects which so many other able astronomers claim are either nearly invisible or totally non-existent. The writer of this review is as ignorant as any astronomer can well be of the objectivity of all these claimed observances on the face of our neighboring planet. During seventeen years' experience as an observational astronomer he has never had an opportunity of seeing Mars through a larger aperture than 4″.5. That he was requested

to write this review for SCIENCE was, therefore, probably due to this qualification as most likely to produce an unbiased summary of the book.

With this explanation, he will proceed to point out what seem to be the strongest points and best features of this Volume III. of the *Annals of the Lowell Observatory,* besides those already mentioned above.

Results secured at the opposition of 1894: At Flagstaff 116 new canals were discovered, 44 in the dark regions and 72 in the light: reobservation was made of 67 out of 79 of Schiaparelli's earlier discoveries, which verified the fixity both of existence and of position (though not the continuous visibility) of the canals: seasonal changes were disclosed by observed changes in the markings: new knots at intersections of canals were discovered, in the dark regions as well as in the light, thus incidentally exploding the supposition that they are seas, but giving them rather the character of oases: discovery of the so-called carets, where the canals debouched.

Ever bearing in his mind the degree of incredibility attached to these announcements by most astronomers, the author points out that the times of nearest approach of Mars through the epoch most usual for observing may not be always the most propitious season for multiplicity of detail. He also expresses the opinion that the failure of others to see the canals may be due to their looking at a "featureless face" (page 7). On page 4, he also points out a wide distinction between "sensitive eyes" and "acute eyes" and shows that a high ability to detect faint stars or satellites may be the very criterion which would presumptively preclude its possessor from the securing of a retinal impression of such surface features as Martian canals, etc. This opposition was observed with an eighteen-inch Brashear objective, usually with a power of 320.

At the opposition of 1896, a Clark objective of twenty-four inches was used. At first, for about three months at Flagstaff, and afterwards at Tacubaya, Mexico, the powers used ranged from 163 to 528. Three hundred and forty-one drawings of the complete disk were made at this opposition. As results, the enumeration includes many double canals—some being always double, others only at certain seasons of the Martian year. Evidence of the canals in the dark regions as well as in the light; and the subjective discovery that the detail of canals and oases came out finer and more minute as experience grew; and that many apparent changes in appearances arose "not because of change in them, but because of growing aptitude in the observer."

At the opposition of 1900, some canals were seen still always double: and that, too, independently of the apertures of the telescope objective or of the optical interference bands. Discovery was also made of bright spots in various parts of the planet, and at times difficult to explain. Though seemingly fixed in location, they were subsequently regarded as Martian clouds.

The opposition of 1903 was observed continuously for seven months while the tilt of the planet's north pole towards us was nearly at its greatest possible angle. The main results were noting the connection between the oases and the double canals, the oases being exactly embraced by the two arms of the double, and the oases were round and the canals tangent at the extremities of a diameter. Also the observer noted an apparent contradiction of Schiaparelli's announcement in 1888 of a change of longitude of Lucus Ismenius. Changes of color were noted, and a semi-annual flux in the development of canals, together with a complete confirmation of the objectivity of the canal gemination, and much additional information was gained as to the nature of that gemination.

In the Supplement, page 53, the author calls particular attention to Mr. Douglass's remarkable set of observations on the "projection" of December 7–8, 1900, and affirms that his observations and drawings showed conclusively that the successive appearances could be explained only by *clouds,* and were perfectly satisfied by that explanation.

HERMAN S. DAVIS

DOVER, DELAWARE

SOCIETIES AND ACADEMIES

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE. TWENTY-THIRD MEETING

New York University and Bellevue Hospital Medical College, May 22, 1907. President Flexner in the chair. Members present—Atkinson, Beebe, Brooks, Calkins, Carrel, Emerson, Ewing, Field, Flexner, Gibson, Gies, Lillie, Lusk, Meyer, Murlin, Salant, Shaffer, Teague, Wadsworth, Weil, Wolf, Yatsu.

Abstracts of the Communications[1]

The Osmotic Pressure of Colloidal Solutions and the Influence of Electrolytes and Non-electrolytes on such Pressure: Ralph S. Lillie.

Determinations were made of the osmotic pressure of gelatin and egg albumin. The colloids were used (1) in approximately pure solution, and (2) after the addition of various electrolytes and non-electrolytes to the colloidal solution; in this case the employed substance was added in the same concentration to the outer fluid of the osmometer so as to pervade the entire system on both sides of the membrane in uniform concentration. The osmotic effects observed under these conditions can be due only to the colloid and not to the added substance. The colloidal solution was found, however, after the addition of an acid, alkali or neutral salt, to exhibit an altered osmotic pressure, the degree of alteration varying with the nature and concentration of the added electrolyte. Non-electrolytes were found to have no appreciable influence on the osmotic pressure of these colloids.

Hemolysis in Eclampsia: James Ewing.

The author's observations indicate that the eclamptic toxin is not a hemolytic agent derived from the placenta, and that hemolysis is not necessarily associated with the lesions of the viscera. Semb's experiments in which he demonstrates visceral lesions strongly resembling those of a hemolytic serum, can not be accepted as furnishing evidence of a specific eclamptic toxin. Histological study of the liver in eclampsia indicates that the characteristic lesions consist of fibrin thrombi and not in agglutination and hemolysis of red cells, and that when hemolysis occurs it results from the products of degeneration and necrosis of endothelial and hepatic cells. It is therefore probably an entirely secondary factor in the disease.

Glycocoll Nitrogen in the Metabolism of the Dog: John R. Murlin.

While attempting to explain the behavior of gelatin in metabolism it occurred to the author that much significance might be attributed to its high content of glycocoll. It is well known that the nitrogen of gelatin is not ordinarily retained in the body, but appears quantitatively in the urine, chiefly as urea. But when fed with meat and an abundance of carbohydrate, it is possible to establish nitrogen equilibrium near the fasting level, if two thirds of the total quantity of nitrogen fed is given in the form of gelatin and only one third is present in the meat. Would glycocoll, if given in the same way, behave as does gelatin? The author's experiments answered this question in the affirmative.

An Hydrodynamic Explanation of Mitotic Figures: Arthur B. Lamb.

The distinctly polar arrangement of the chromatin substance about the astral centers in dividing cells, combined with the pronounced curvature of the astral rays and of the spindle fibers, has demanded the assumption of some polar force as universally operative. On such an assumption it is of course necessary to assume further that astral centers represent either opposite or like poles. On the alternative of opposite poles, we should expect, with any force so far proposed, a configuration of astral rays simulating that of iron filings between *opposite* magnetic poles, coupled with a mutual *attraction* of the astral centers. On the other alternative, we should similarly expect a configuration of astral rays and spindle fibers simulating that of iron filings between *like* magnetic poles, coupled with a mutual

[1] The abstracts presented in this account of the proceedings have been greatly condensed from abstracts prepared by the authors themselves. The latter abstracts of the communications appear in Number 6 of Volume IV. of the Society's proceedings, which may be obtained from the Secretary.

repulsion of the astral centers. Actually, we have neither of these conditions, but instead, a configuration like that of iron filings between *opposite* magnetic poles *and at the same time an apparent repulsion between the astral centers or the centrosomes.*

This is not the case with the forces of attraction or repulsion existing between bodies oscillating or pulsating in a fluid medium. More specifically, if two spheres are pulsating synchronously, and in opposite phase, or oscillating synchronously and in the same phase, they will repel one another, *but at the same time the field between them will simulate the configuration of iron filings between opposite magnetic poles.*[2]

If then we assume that the centrosomes are pulsating in opposite phase, or better, oscillating in the same phase, we shall obtain the desired repulsion and at the same time have a configuration like that actually observed.

The configuration taken by the chromosomes is explicable on the same grounds. Indeed, it is not necessary to assume any independent motion on their part, but simply to consider it an induction phenomenon. The tri- and multi-polar spindles are also better explained on these hydrodynamic grounds than on previous assumptions.

The foregoing explanation is, of course, pure hypothesis, with no support other than the facts it seeks to explain. There is, however, nothing inherently impossible in it, and it may provoke fresh observation and new ideas.

Transfusion Experiments on Dogs, showing Artificially Implanted Tumors: GEORGE W. CRILE and S. P. BEEBE.

Direct transfusion of the whole blood from immune dogs to dogs with actively growing, artificially implanted tumors has been conducted in six animals. In the first set of three, sufficient time has elapsed to determine the outcome, which was as follows:

I. Dog 116. Planted January 7, 1907. Tumors were first seen on February 20; continued to grow slowly. March 20, transfusion experiment: dog was bled 400 c.c. and immediately transfused with 550 c.c. of blood from dog 244, in which implantation had occurred on January 18; tumors were first noticed on February 6, and had continued to grow until February 20, when they began to regress. Regression complete March 7. Three days after transfusion, dog 244 was again planted with tumor. Four plants were made with positive results in three and tumors are growing at the present time. The immunity which dog 244 possessed as a result of the previous growth and regression of the tumors could not have been very marked. The effect of this transfusion upon tumors of dog 116 was negative, since they continued to grow until the death of the animal in a cachetic condition four weeks later.

II. Dog 125. Weight 13 kilos. Tumors were planted December 6. All plants grew and continued to increase in size until the day of transfusion, March 20. On this day the dog was bled 500 c.c. and immediately transfused with the same quantity of blood from dog 163. Following the bleeding and transfusion the tumors of dog 125 became softer and began to regress. One tumor has entirely disappeared and the others are subsiding.

III. Dog 133. Weight 17 kilos. Tumors planted January 31; first growth noticed February 13, and continued active until day of transfusion. March 20, bled 600 c.c. and transfused 1,500 c.c. from dog 289. The latter animal was 19½ kilos in weight, in very good physical condition and naturally immune to the tumor. Following this transfusion, which was the largest and of the best quality that any animal in this series received, the tumors of dog 133 began to regress immediately, and at the present time the regression is complete.

The authors postponed discussion of these results.

Transplantation of the Thigh from One Dog to Another: ALEXIS CARREL.

On April 23, 1907, at 9:50 A.M., a medium-sized dog was killed with chloroform. At 10:20 A.M. the left thigh of the cadaver was amputated just below its middle part, perfused with Locke solution and placed on a

[2] See Bjerknes's text-book, "Hydrodynamische Fernkräfte," J. A. Barth, Leipzig, 1902.

table of the laboratory, the temperature being 88–90° F.

At 11 A.M. a medium-sized bitch was etherized; her left thigh was amputated and immediately replaced by the thigh of the dead dog. The reconstruction of the thigh began by the suture of the bone, the adductors and quadriceps. Then the femoral vessels were united and the circulation reestablished at 1 P.M. The operation was completed by the suture of the nerves, muscles, aponeuroses and skin, and the limb placed in a plaster of Paris apparatus.

On April 23, 24 and 25 the animal remained in good condition and walked on her three normal feet. The transplanted limb was warmer than the normal one and its circulation very active. On April 26 she appeared to be sick. There was a phlegmon of the thigh. Incisions were made in Scarpa's triangle and on the transplanted limb, which was warm. Hemorrhage of red blood occurred from the incisions in the transplanted limb.

During the succeeding days, the circulation of the limb remained active, the foot became swollen and the general condition of the animal declined. On May 1 a large abscess was detected near the pelvis and opened. A small incision having been made on the foot of the transplanted limb, hemorrhage of red blood occurred. The general condition of the animal was very low. On May 2 the animal died of septicemia.

Then it was found that the lumen of the femoral vessels was free from thrombus, and the intima smooth and glistening. There was no deposit of fibrin on the lines of suture. In spite of the infection, the union of the vessels was excellent. The skin and the muscles were cicatrized and the ends of the femur firmly united by the ligature.

The Bacteriotherapy of Leprosy: PAUL G. WOOLLEY (by invitation).

It seemed to the author that, lacking pure cultures for the purpose, he might make the leprosy patient serve as his own culture medium. It is well known how abundant are the bacilli in the lepra nodule. The author excised a nodule from the arm of an advanced and wretched case of the tubercular form of leprosy. The nodule was very rich in bacilli. It was ground with sand and salt solution; centrifugalized; heated to 65–70° C. for fifteen minutes, and treated with enough 5-per-cent. carbolic acid to make a suspension containing 0.5 per cent. of the acid. This suspension was rich in bacilli. Of it subcutaneous inoculations of 0.01 c.c. were made at intervals, the intervals depending on the general condition of the patient. Experience with the more exact methods possible with the analogous disease, tuberculosis, indicates that minimal inoculations of the dead bacilli must be continued over a long period before a genuine arrest is attained; even, therefore, with the most favorable outcome, the author does not expect to report the results of this treatment for months to come. The author communicated the method in order that others with fuller opportunities may test it.

Direct Silver Staining of Spirochetes and Flagellated Bacteria: SIMON FLEXNER.

The discussion of the nature of the structure now called *Spirocheta* (*Treponema*) *pallida*—whether a microorganism or some histological elements—led Flexner to try to effect the silver staining directly upon smear preparations prepared from serum exudates obtained from syphilitic lesions. While engaged unsuccessfully in this endeavor, Stern,[3] of Prag, published a simple method for staining the spirochetes directly with silver nitrate. When the deposit of silver presents a metallic sheen the impregnation is regarded as sufficient. Flexner has found the method very simple and sufficient; but he has obtained better results from long (3–4 days) than from short (1–2 days) exposures. The length of exposure required will depend somewhat upon the weather (strength of light) and the thickness of the spread. Moderately heavy spreads have given him better results than thinner ones, and impression preparations better than smear preparations.

Other spirochetal organisms, from the buccal cavity, etc., may be silvered by this method, and bacteria may also be silvered. In a

[3] Stern, *Berl. klin. Woch.*, 1907, XLIV., 400.

few comparative tests which were made, the degree of impregnation was greatest with the pallida. Whether this is to be accounted for by elective affinity or difference of medium in which the organisms were embedded can not be said. In the course of these examinations the author came across examples of flagellated bacteria from the buccal cavity in which the flagella were distinctly silvered. He attempted to stain the flagella of certain bacteria—*B. typhosus, paratyphosus, pyocyaneus, hog cholera*—from pure cultures, but unsuccessfully. The terminal cilia of the pallida appeared not to be stained by the silver.

Flexner observed instances in which the silvered films showed many more *spirochetæ pallida* than the corresponding preparations stained by Giemsa's or Proca's methods.

On the Bacterial Production of Skatol and its Occurrence in the Human Intestinal Tract: C. A. HERTER.

A large number of facultative and strict anerobic organisms have been studied with respect to their ability to form skatol. The anerobes *B. putrificus* (strain isolated by Bienstock) and one strain of the bacillus of malignant edema (obtained from Professor Theobald Smith) were found to produce skatol in peptone bouillon, although it was not possible to determine the conditions under which skatol could be regularly obtained through the action of these bacteria. It was found that skatol is rarely present in the intestinal tract except in conditions of disease associated with intestinal putrefaction. Usually skatol is associated with indol in such conditions, although there are instances in which the intestinal contents exhibit little or no indol but, relatively speaking, considerable skatol. This has been observed heretofore only in putrefactive processes associated with pronounced clinical manifestations.

A Spirochete found in the Blood of a Wild Rat: W. J. MACNEAL.

Of thirty-nine wild rats (*Mus decumanus*) caught at Morgantown, W. Va., by MacNeal, one has shown a minute, actively motile, spiral organism in the blood. It is present in very small numbers and careful search with high magnification is necessary to detect its presence.

The parasite stains readily by the various modifications of the Romanowsky stain, and very intensely by the rapid method recommended for clinical staining of *Spirocheta pallida.*[4] It takes a uniform, deep, violet-red color. The measurement of a number of individuals shows a marked variation in length, the shortest forms, consisting of one and three quarters turns or nodes, having a length of 1.75 μ; the longest, consisting of three and one half turns, being 3.55 μ long.

The infection is readily transferred to other wild rats by intraperitoneal injection of a very small drop of infected blood in normal salt solution. In many cases, not more than ten or twenty parasites could have been present in the injection, yet, so far, the wild rats have always developed the infection. The parasites never become very numerous and disappear in from one to nine days. This apparent recovery is then followed by repeated relapses. The parasite may become more numerous in the blood during the relapse than in the primary invasion. Neither a certain recovery nor a fatal result has, as yet, been observed.

White rats are susceptible, with an incubation period of four to eight days according to the dose employed. The house mouse (*Mus musculus*) is apparently more resistant.

Similar spirochetes have been described by Carter (in the rat), by Lingard (in the bandicoot, *Mus giganteus*), by Nicolle and Comte (in the bat), by Wenyon and by Breinl and Kinghorn (in the house mouse); all these in the circulating blood. Borrel and Gaylord have described spiral organisms in mouse carcinomata, and one of the forms found by Borrel has been shown by Wenyon to be identical with his *Spirocheta muris,* found in the blood of mice. Morphologically the parasite found here in the rat is apparently identical with this one of Borrel and Wenyon. Its behavior in animals is somewhat different. MacNeal tentatively proposes for it the name *Spiro-*

[4] MacNeal, *Journal Amer. Med. Assn.*, February 16, 1907.

cheta muris, var. *Virginiana*, following the principle suggested by Calkins.[5] Its specific relation to that organism must be left for further work to determine.

Experimental Ligation of Splenic and Portal Veins, with the Aim of Producing a Form of Splenic Anemia: Aldred S. Warthin.

The author's results indicate that obstruction of the splenic veins of dogs by ligation is not followed by a fibroid hyperplasia of the spleen but by a partial atrophy. A more or less complete venous collateral circulation is always produced. The picture of splenic anemia as seen in man can not, therefore, be reproduced in the dog, by an obstruction to the venous outflow from the spleen.

An Experimental Control of Fischer's Attraxin Theory: C. Snow. (Communicated by Aldred S. Warthin.)

Fischer recently reported from Ribbert's laboratory[6] that by injecting a solution of Scharlach R, Sudan III. or Indo-phenol in olive-oil under the skin of the ears of rabbits he was able to get an epithelial proliferation which was not to be distinguished histologically from a squamous-celled carcinoma in man. He was not able to get this result with other substances acting as irritants, and therefore assumed the existence of specific bodies—attraxins—in the injected solution, which exerted a chemotactic influence on the epithelial cells.

His work has been repeated by Snow as nearly as was possible from the meager description given of his technic. Three old and three young rabbits received, under the skin of the ear, injections of the Scharlach R-olive-oil solution, and the injected tissue was excised and examined at times varying from 7 to 61 days. The results show that the solution has absolutely no influence on the epithelial elements, but acts as a mild irritant, inducing a chronic inflammation with slight reaction on the part of the connective tissue in the case of the old rabbits, and a greater reaction, with the formation of foreign-body giant cells, in the case of the young rabbits, the conclusion being that the attraxin theory is without sound foundation, so far as "Scarlet-oil" is concerned.

The Effects of Struggle on the Content of White Cells in the Lymph: F. Peyton Rous. (Communicated by Aldred S. Warthin.)

Preliminary determinations, with the animal (dog) quiet, showed that for any one individual the number of leukocytes per cubic millimeter of lymph, from the thoracic duct, was practically constant during the 1 to 4 hours during which observations were made. With struggle, as others have shown, the lymph flow increases sharply in amount for a few minutes. With this the author found a corresponding increase in cell content, an increase marked in "cell concentration" per cubic millimeter of lymph and in the total number of elements passed.

An additional conclusion was that, for a given individual, the lymph glands seem "set" to produce cells at definite rates. These rates have a wide range for reasons unknown. The cell increase with struggle comes from the peripheral lymph system rather than from sedimented cells in the receptaculum chyli, and is probably dependent on another factor besides increased lymph flow (a supposition upheld by later experiments with lymphagogues).

The facts elicited have a bearing on the "physiological mononucleosis" of the blood observed in man following active exercise, on the disappearance of this after prolonged exertion (25-mile run), and the absolute decrease in mononuclears sometimes seen.

A Lipolytic Form of Hemolysis: Hideyo Noguchi.

Lipase is, under some conditions, an efficient hemolytic agent which acts, however, not directly upon the red corpuscles, but indirectly through the liberation from available fats of the active fatty acids. Neutral fats are not hemolytic, but they become so under the influence of lipase.

[5] Calkins, *Journal of Infectious Diseases*, April 10, 1907.

[6] Fischer, *Münch. med. Wochenschrift*, October 16, 1906.

Potassium cyanide and sodium fluoride in 1:10,000 solution inhibit the action of lipase on the fats, and calcium chloride removes the lytic agent from an active mixture. Since the bile salts are known to increase lipolysis, the effects of the sodium salts of cholic, glycocholic and taurocholic acids in *n*/500 solutions were tested on lipolytic hemolysis. The rate of hemolysis was accelerated.

On the Mechanism by which Water is eliminated from the Blood Capillaries in the Active Salivary Glands: A. J. CARLSON, J. R. GREER and F. C. BECHT.

There is a spontaneous flow of lymph from the quiescent parotid gland of the horse. It is probable that part of the lymph that flows from the neck lymphatics in an anesthetized dog with all the salivary glands at rest comes from the salivary glands. When the parotid of the horse is thrown into activity by stimulation of the cranial secretory nerves, or by injection of pilocarpin into the blood, there is no appreciable increase in the output of lymph from the gland as compared with that from the gland at rest. This is true both of the spontaneous flow and of the flow aided by direct massage of the gland. The activity of the submaxillary does not appreciably influence the flow of lymph from the neck lymphatic in the dog. This conclusion is based on experiments on thirteen dogs. If the activity of the submaxillary gland increases the output of lymph from the neck ducts, the increase is too slight to be detected by present methods, and is not one tenth of the saliva eliminated by the gland, as Barcroft's observations would seem to demand.

In dogs under *light* ether anesthesia, perfectly quiescent and with all the salivary glands at rest, there is always a spontaneous flow of lymph from the neck lymphatics.

The osmotic pressure of the lymph from the active parotid of the horse is not the same in all animals. The lymph obtained from the active gland had in three cases considerably lower osmotic pressures than the serum, a fact which apparently eliminates osmosis as the factor effecting the transfer of water from the blood capillaries in the active gland. The osmotic pressure of the lymph from the neck lymphatics of the horse, collected with the animal under chloroform anesthesia, may be of slightly higher, of the same or of considerably lower osmotic pressure than the serum. The osmotic pressure of the lymph from the neck lymphatics of the dog is usually lower than that of the serum. It is rarely greater. The thoracic lymph was in one case of the same, in the other case, of a higher, osmotic pressure than the serum. It is therefore probable that the osmotic pressure of the thoracic lymph is usually greater than that of the neck lymph.

Under the conditions of the experiments—ether or chloroform anesthesia for from two to four hours—the osmotic pressure of the serum at the end of the experiments was in many cases greater than at the beginning. The same difference is sometimes exhibited by the lymph collected from the same lymphatic, but at different periods of the experiment.

On the Dissociation in Solutions of the Neutral Caseinates of Sodium and Ammonium: T. BRAILSFORD ROBERTSON.

In the case of the neutral caseinate of *sodium* the sum of the ionic velocities was found to be slightly greater than the velocity of the Na ion, indicating a specific velocity of 2.6×10^{-5} cm. per second for the casein anion at 25° C. In the case of *ammonium* caseinate, however, the sum of the ionic velocities was found to be considerably *less* than the specific velocity of the ammonium ion. This was interpreted as indicating the presence in this solution of complex cations containing ammonium. Other considerations show that the effect is not due to viscosity. If casein be regarded as an ampholyte of the type HXOH, the sodium salt would be of the type $Na^+ + XOH^-$; it is possible that the ammonium salt in solution forms ions of the type $NH_4X^+ + OH^-$ or $NH_4X^+ + XOH^-$.

The Altmann Granules in Kidney and Liver and their Relation to Granular and Fatty Degenerations: WILLIAM OPHÜLS.

In the kidneys of dogs, rabbits and guinea-pigs the author found the following arrange-

ment of the Altmann granules: In the connecting and convoluted tubules, and in the descending parts of the loops of Henle, the granules are rather coarse, very definitely rod-shaped and arranged in radial rows in the basilar two thirds of the cells, often so closely set end to end that it is difficult to make out the dividing lines between them. In the part of the cells directly adjoining the lumen there are few scattered short rod-shaped granules and none in the "Bürstenbesatz." These details are naturally more plainly shown in the large cells of the convoluted tubules, but in a general way the smaller cells in the connecting tubules and in the descending loops of Henle resemble them very closely. Some groups of convoluted tubules have much coarser granules than others. Ophüls has not been able to make out whether this is a constant anatomic difference or due to different functional stages. If the granules have any relation to the function of the cells, which seems probable, one would surmise that the connecting tubules can not purely serve the function of conducting urine from one place to another, all the more so since in the large ducts of the pyramids which serve this purpose alone, the granules are very scanty and irregularly arranged. In the large light cells of the ascending parts of the Henle loops, the granules are exceedingly small, also slightly rod-shaped, extremely numerous and scattered all through the cells in an irregular fashion. This condition might be used as an argument in favor of a difference in function of this portion of the tubules. In the cells of the liver of these animals the granules vary greatly in size from just visible to quite coarse granules. All of them are rods, some short, others quite long and more or less wavy. The granules are scattered irregularly all over the cells.

In granular degeneration, the characteristic macroscopic and microscopic pictures of which can be best produced by intravenous injection of potassium bichromate, the granules enlarge in size, become more or less spherical, lose their normal arrangement and stain very deeply with the Altmann stain, contrary to what has been generally assumed after the work of Schilling,[1] who seems to be the only investigator of this question. In the liver the change is similar, all cells being equally involved. The albuminous granules in granular degeneration, then, are not newly formed granules, but to a great degree the enlarged and disarranged normal Altmann granules. The author's observations on the kidneys and liver confirm the view that in fatty degeneration, fat in all cases appears first in and around the Altmann granules. It seemed more as if the granules were changed to fat *in toto*.

These observations indicate why granular degeneration and fatty degeneration so frequently occur simultaneously, for both appear to be the result of abnormal conditions in the Altmann granules.

The Relation of Anatomic Structure to Function: William Ophüls.

The kidney appeared to be the organ best suited for the study of this problem, for by collection of the urine directly after its discharge from the ureters, the exact moment of the occurrence of the disturbance could be ascertained. It is possible to produce albuminuria in dogs within a few hours by intravenous injection of potassium bichromate (about 2–3 c.c. of a 2-per-cent. solution). If Altmann specimens are made from the kidneys at this time no lesions are found. That the poison, nevertheless, acts upon the epithelial cells and the granules in them is shown by the subsequent development of severe lesions.

In phlorhizin glycosuria, likewise, no lesions are demonstrable by this method, although we are fairly certain that the excretion of sugar in this case is due to a lesion in the kidney.

The author believes that quite a number of the anatomic changes which we now look upon as primary, are the result rather than the cause of the functional disturbances, although the disarrangement brought about by them naturally often aggravates the original condition. It is questionable whether the real primary lesion in these cases is of such character as ever to be demonstrable by physical methods.

[1] Schilling, *Virch. Arch.*, 1897, CXXV., 410.

Protein Poisons: VICTOR C. VAUGHAN.

The author has been able by diverse methods to split proteins—bacterial, vegetable and animal—into poisonous and non-poisonous products.

The poisons obtained from the different proteins are similar, but are not identical. All are soluble in both water and absolute alcohol, more freely in the latter than in the former. The aqueous solutions are acid and slowly decompose sodium bicarbonate, forming salts, apparently, and these are less poisonous than the free acids. The aqueous solutions give the general color reactions for proteins with the exception of that of Molisch, and some of them give this reaction. However, most of the protein poisons obtained by cleavage of the protein molecule contain no carbohydrate and are free from phosphorus.

These poisons when injected into animals intra-abdominally, subcutaneously or intravenously induce characteristic symptoms and when administered in sufficient quantity kill promptly.

Death is due to failure of respiration and the heart often continues to beat for some minutes after respiration has ceased. It seems most probable that death is due to the direct action of the poisons on the respiratory center. It is inferred from the readiness with which recovery may follow non-fatal doses that the poison cripples, but does not destroy, the cells of the respiratory center.

All attempts to produce antitoxins with these protein poisons have, so far, failed. It is true that repeated treatments of animals with non-fatal doses of the poisons from the colon and typhoid bacilli enable animals to bear from two to four times the ordinarily fatal doses of living cultures of these bacteria, but this seems to be due to an increased resistance rather than to a true immunity. This condition is not specific and may be induced by the poisons obtained from peptone or egg white, as well as with that obtained by cleavage of the homologous bacterium.

Attempts have been made to ascertain the chemical constitution of the protein poisons by splitting them up with mineral acids, but at present these experiments have not yielded satisfactory knowledge, and work along this line is being continued. The physiologic action of the protein poisons leads to the suspicion that they contain a neurin group, but so far the author has not been able to demonstrate the presence of such a radical.

Observations on the Living, Developing Nerve Fiber: ROSS G. HARRISON.

The immediate object of the author's experiments was to devise a method by which the end of a growing nerve could be brought under direct observation while alive, in order that a correct conception might be had regarding what takes place as the fiber extends during embryonic development from the nerve center to the periphery.

The method employed was to locate pieces of embryonic tissue known to give rise to nerve fibers, as, for example, the whole or fragments of the medullary tube, or ectoderm from the branchial region, and to observe their further development. The pieces were taken from frog embryos about 3 mm. long, at which stage, *i. e.*, shortly after the closure of the medullary folds, there is no visible differentiation of the nerve elements. After carefully dissecting it out, the piece of tissue is removed by a fine pipette to a cover slip, upon which is a drop of lymph freshly drawn from one of the lymph sacs of an adult frog. The lymph clots very quickly, holding the tissue in a fixed position. The cover slip is then inverted over a hollow slide and the rim sealed with paraffin. When reasonable aseptic precautions are taken, tissues will live under these conditions for a week and in some cases specimens have been kept alive for nearly four weeks. Such specimens may be readily observed from day to day under highly magnifying powers.

While the cell aggregates, which make up the different organs and organ-complexes of the embryo, do not undergo normal transformation in form, owing no doubt in part to the abnormal conditions of mechanical tension to which they are subjected, nevertheless, the individual tissue elements do differentiate characteristically. Groups of epidermal cells

round themselves off into little spheres or stretch out into long bands, their cilia remain active for a week or more and a typical cuticular border develops. Masses of cells taken from the myotomes differentiate into muscle fibers showing fibrillæ with typical striations. When portions of myotomes are left attached to a piece of the medullary cord, the muscle fibers which develop will, after two or three days, exhibit frequent contractions. In pieces of nervous tissue numerous fibers are formed, though owing to the fact that they are developed largely within the mass of transplanted tissue itself, their mode of development can not always be followed. However, in a large number of cases fibers were observed which left the mass of nerve tissue and extended out into the surrounding lymph clot.

It has not yet been found possible to make permanent specimens which show the isolated nerve fibers completely intact. The structures are so delicate that mere immersion in the preserving fluid is sufficient to cause violent tearing and this very frequently results in the tearing away of the tissue in its entirety from the clot. Nevertheless, sections have been cut of some of the specimens and nerves have been traced from the walls of the medullary tube, but they were in all cases broken off short.

In view of this difficulty an effort, which resulted successfully, was made to obtain permanent specimens in a somewhat different way. A piece of medullary cord about four or five segments long was excised from an embryo and this was replaced by a cylindrical clot of proper length and caliber, which was obtained by allowing blood or lymph of an adult frog to clot in a capillary tube. No difficulty was experienced in healing the clot into the embryo in proper position. After two, three or four days the specimens were preserved and examined in serial sections. It was found that the funicular fibers from the brain and anterior part of the cord, consisting of naked axones without sheath cells, had grown for a considerable distance into the clot.

These and many other interesting observations described by the author show beyond question that the nerve fiber develops by the outflowing of protoplasm from the central cells. This protoplasm retains its amœboid activity at its distal end, the result being that it is drawn out into a long thread which becomes the axis cylinder. No other cells or living structures take part in this process. The development of the nerve fiber is thus brought about by means of one of the very primitive properties of living protoplasm, amœboid movement, which, though probably common to some extent to all the cells of the embryo, is especially accentuated in the nerve cells at this period of development.

The Presence of Allantoin in the Urine of the Dog During Starvation: Frank P. Underhill.

During the progress of an investigation upon intermediary metabolism, it became necessary to subject the experimental animals to periods of starvation lasting from ten days to two weeks. From the urine of these dogs allantoin separated spontaneously in pure white crystals and the presence of this substance in the urine was constant. The presence of allantoin in the urine during starvation has not been recorded hitherto. This observation makes it probable that allantoin is a constant constituent of the urine of the dog.

Alkaloidal Compounds of Mucoids, Nucleoproteins, and other Proteins: Walter H. Eddy and William J. Gies.

In continuation of their studies of protein compounds the authors have observed that nucleoprotein, mucoid, caseinogen and alkali albuminate form water-soluble products with alkaloids. By intimately mixing samples of the purified moist protein and the pure alkaloid, especially with the latter in considerable excess, soluble products are formed, which may be precipitated by alcohol or alcohol-ether, and which, after purification and drying, readily dissolve in water. Such aqueous solutions are neutral to litmus, and the proteins may be readily precipitated from the solutions by slightly acidifying them.

The purification of such products as well as their chemical and pharmacological study, is under way.

William J. Gies,
Secretary

DISCUSSION AND CORRESPONDENCE

ORIGIN OF SINK-HOLES

THE writer has read with much interest Professor A. H. Purdue's paper in the issue of SCIENCE of July 26, 1907, on "Origin of Limestone Sink-holes." In this connection it may be of further interest to call attention to a type of sink-hole very frequently met with in Florida formed under conditions apparently not included in Professor Purdue's discussion.

The surface deposits throughout much of the interior of Florida consist of sands and clays with occasional limestone layers. These deposits are variable, being in some places almost entirely absent, while in others they are of considerable thickness. Beneath these surface accumulations occurs a limestone of undetermined thickness. This foundation limestone, which is for the most part porous, holds inexhaustible supplies of water, and is traversed by solution cavities.

When first formed, the typical sink throughout this area is an opening leading from the surface through the superficial deposits to or into the limestone below. Many of these sinks are perfectly cylindrical, not funnel-shaped. This is especially true of the smaller sinks. As a result of subsequent caving of the banks, the bottom usually becomes clogged and the sides sloping. The formation of these sinks is practically instantaneous and results from a sudden caving of the earth. In size they vary from a few feet to many rods in diameter. So frequent is their formation in certain sections, notably the phosphate mining area of Alachua and Columbia counties, that one must be on the lookout in driving through the country for newly formed sinks. Indurated layers exposed along the sides of the sink are rough-edged and bear evidence of fracture due to the sudden giving away and breaking under the weight of the load above. The depth of the sinks is probably quite variable. As a rule, they reach through and connect with the permanent underground water horizon. Some reach much below the water line.

The type here described is not merely a modification of the type described by Professor Purdue. This is evident from the fact that the static head of the water in many, though not all, of these sinks is such as to bring it above the top surface of the limestone. There is abundant evidence of solution in the limestone at all depths, both above and below the static head of the underground water. It is apparent, however, that the conditions existing in the limestone below the water level are not such as to bring about a funnel-shaped cavity. This point would scarcely seem to call for emphasis were it not that Professor Purdue considers the cave-in sink the rare exception.

A sink of this type was examined by the writer within a few hours after its formation about one mile south of Juliette in Marion County in 1905. This was a small sink, not more than eight feet in diameter, and of the usual cylindrical form. The sides down to the water level were, so far as could be determined, entirely of clay. The sink which had formed directly under the railroad track was caused possibly by the jar of a passing train, the engine of which had passed safely over. The water rose immediately in the sink to the static head of the water of that locality.

The writer recalls having often seen similar tubular openings reaching from the surface to the runway of abandoned coal mines, the "cave-in" occurring in these cases through a thickness of forty or fifty feet of clays and shales. From analogy it seems probable that the formation of the sinks in question results from a gradual caving of the clay from the bottom, assisted, perhaps, by the removal mechanically of a part of the material by underground water. Finally a point is reached at which the entire remaining mass suddenly gives way. While some of these sinks are in clay formations entirely, others break through considerable thicknesses of limestone.

E. H. SELLARDS

SPECIAL ARTICLES

NOTE ON THE MAGNETIC FIELD DUE TO AN ELECTRIC CURRENT IN A STRAIGHT WIRE

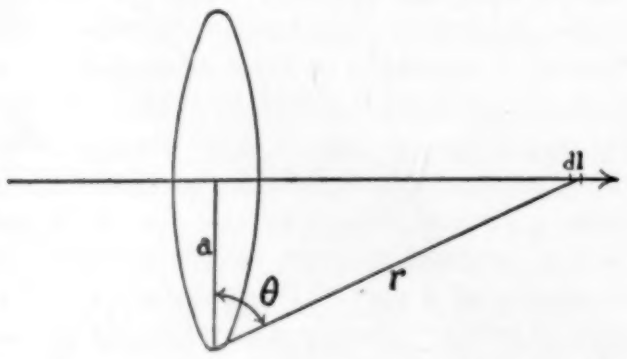
The force in dynes on a unit magnetic pole at any point outside an infinitely long straight

wire carrying a current is, as we know, tangent to a circle through whose center the wire passes at right angles, and is numerically equal to $2C/a$, where C is the current in absolute units, and a the distance in centimeters of the point from the axis of the wire.

While the approximate direction of the force is easily found experimentally, its numerical value is determined only by integrating the effects of all parts of the current. And since the force is in a plane at right angles to the wire, it is not an easy matter to make clear to students beginning the subject why it is necessary to consider parts of the wire off this plane.

This is one of the many places where the electron theory can be used to marked advantage, and besides, if, as many believe, it is the correct theory—or embraces a larger number of facts than any other—then it should be used both in this case and in all others.

Let electrons, all moving in the same direction with the constant velocity V centimeters per second, be uniformly distributed along a straight wire, and let E be the total amount of electricity per centimeter length of the wire. Then, assuming the field of force from each electron to be the same in all directions, that is, moving slowly and undisturbed by other electrons, the rate of change of induction, due



to the electricity at all parts of the wire, through a circle at right angles to it of radius a; or in other words, the work required to carry a unit magnetic pole once around this circle (see the figure) is given by the equation

$$\frac{dF}{dt} = 2\int_0^\infty \frac{Edl}{r^2}\, 2\pi a V \cos\theta.$$

But $\cos\theta dl = rd\theta$, $1/r = \cos\theta/a$, and $EV = C$, the current.

Hence

$$\frac{dF}{dt} = 4\pi C\int_0^{\pi/2} \cos\theta d\theta = 4\pi C,$$

and therefore the force on a unit pole at any point on the circumference of a circle of radius a is

$$\frac{4\pi C}{2\pi a} = \frac{2C}{a}.$$

However, presumably the field due to each electron is influenced by all others, and so influenced that it is confined to a plane at right angles to the wire, but equal in every direction from it. From this it follows at once that

$$\frac{dF}{dt} = 4\pi EV = 4\pi C,$$

and

$$f = \frac{4\pi C}{2\pi a} = \frac{2C}{a}.$$

According to this conception, which I believe to be the correct one, the magnetic force at any point is due entirely to that part of the current nearest to this point; the more distant parts having no direct effect whatever. But, of course, as just explained, all electrons produce their full effects indirectly by compressing each other's fields into planes at right angles to the wire.

While the above contains nothing new in physics, it is given because it, or some modification of it, may be of use in the class-room.

W. J. Humphreys
Mount Weather Observatory,
Bluemont, Va.,
June, 1907

Reflex Protective Behavior in Bufo Variabilis

During the past year, while studying the *Opalinae* parasitic in the recta of different species of frogs and toads, I have had to kill many of these batrachians. In each case the backbone and spinal cord were cut behind the head and the brain destroyed by "pithing" with a needle. In this way *Rana fusca, Rana esculenta, Rana agilis, Bufo variabilis, Bombinator igneus, Bombinator pachypus* and *Hyla arborea* have been killed. In all but one of these species I find that, on cutting the

ventral skin to open the abdomen, the hind legs kick vigorously. The exceptional species is *Bufo variabilis,* about a dozen of which I killed in Naples.

The living *Bufo variabilis* is very sluggish. When handled, especially if roughly handled, it remains perfectly quiet, only distending the body to a great size by inflating its lungs. One can prick or cut the animal and produce no effect except a further distention, till the skin is stretched taut as a drum-head. Even cutting the spinal cord never produces much action and often produces none.

The interesting thing is that after one has cut the spinal cord and has destroyed the brain, the animal refuses to react by observable movements to any sort of abuse or injury, remaining as quiet as would an animal upon which no operation had been performed.

Bufo variabilis, like most toads, has very perfect protective coloration. It is further protected by the poisonous secretions from its skin glands. (I have had *Rana esculenta* die from being left twelve hours in a small aquarium, in a little water, with this toad.) The toad's habit of remaining quiet, even under abuse, is probably connected with its protective coloration and poisonous skin secretions, and is doubtless a recent acquisition. This reaction, or rather lack of reaction, in the normal animals may be either "conscious," or reflex, or both. In the animal whose brain has been destroyed it must be purely reflex.

MAYNARD M. METCALF

WÜRZBURG, BAVARIA,
July 3, 1907

BOTANICAL NOTES

THE ORIGIN OF ANGIOSPERMS

WITHIN the past few months two important papers have appeared upon the origin of the higher seed plants (angiosperms). The first is by E. A. Newell Arber and John Parkin, of Cambridge University, and appeared in the *Journal of the Linnean Society, Botany* (vol. 38, pp. 29–80, July 11, 1907). In it the authors first refer to the recent progress in our ideas as regards the phylogeny of the gymnosperms, which are evidently closely related to the *Pteridophyta,* and to the increasing isolation of angiosperms. Just as we find closer affinities between gymnosperms and *Pteridophyta,* we find the gap between *Pteridophyta* and angiosperms increased, until "it may be said that no definite theory as regards the origin of angiosperms has up to the present been elaborated." While "the gap that originally existed between the phanerogams and vascular cryptogams was now bridged, in its place there appeared a wide gulf between the gymnosperms as a whole and the angiosperms."

After a summary reference to certain principles of evolution (the law of corresponding stages, homoplasy and mutation) the authors discuss "primitive features among living angiosperms," basing their discussion upon the theory that the typical angiospermous flower is essentially a strobilus. They regard "the simpler, unisexual flowers, including apetalous forms, as derived from an amphisporangiate strobilus by reduction." They restrict the term "flower" to the angiosperms alone, and regard it as typical "when it possesses both micro- and megasporangia, as well as a perianth which in many cases has an attractive function."

In their critical examination of Engler's theory they hold that *Piperales, Amentiferae,* and *Pandanales* are not primitive in type, but that they are reductions from hermaphrodite types with well developed perianths. They regard *Apetalae* as forms "reduced from amphisporangiate strobili, in each case possessing a perianth," and not as primitive plants from which the petalous forms have evolved. In further criticism of Engler's theory, while admitting its merit of simplicity, they affirm that "its application as a working hypothesis does not assist us in our search for a clue to the phylogeny of the angiosperms as a whole: nor does it help to bring this group into line with any of those now known to us in the fossil state."

For the theory which they adopt, namely, "that the monosporangiate apetalae were derived by reduction from an amphisporangiate strobilus possessing a distinct perianth" they affirm that it "leads us back naturally to a

great group of Mesozoic plants, the *Bennettiteae,* which afford the key to the ancestry of the race in question." They then construct a mental picture of a primitive strobilus (flower) consisting of a large, elongated, conical axis, bearing megasporophylls above, and microsporophylls below, and still below these a perianth of usually more than one whorl. Such a primitive flower is conceived to have been polypetalous, hypogynous, and apocarpous. Structures similar to this imaginary primitive flower occur in *Magnoliaceae, Ranunculaceae, Nymphaeaceae* and *Calycanthaceae* among dicotyledons, and in *Alismaceae, Butomaceae* and *Palmaceae* among monocotyledons.

The authors then take up an examination of the *Bennettiteae,* which "appear to afford the long sought for clue to the phylogeny of the angiosperms." They show that in these plants the anthostrobilus is sufficiently like that of the simple angiosperms to warrant the suggestion that the latter are derived from structures much like the former. They are able to reconstruct the anthostrobilus of *Bennettites,* and a comparison of this with the pro-anthostrobilus of the hypothetical *Hemiangiospermae,* and the primitive flower referred to above shows that the steps from the *Bennettiteae* to the angiosperms are easy and quite probable. In their discussion they make one remark which will surprise many a botanist who has not kept in touch with the recent advances in paleobotany, namely: "the seed itself is an exceedingly ancient organ, dating far beyond the period at which we first became acquainted with fossil plants; in other words, it was a highly evolved structure at a very remote period in geological time." Yet while all these early seed plants were gymnospermous, it does not follow that they gave rise to the sub-class *Gymnospermae,* as now understood. On the contrary, it is shown to be probable that the gymnospermous *Bennettiteae* gave rise rather directly to the *Angiospermae.*

The authors show how entomophily helped shape the developing primitive flower, and regard it as an important factor in the evolution of the angiospermous flower. They close their paper with a couple of pages of general conclusions and summary, including a helpful geological table of angiospermous relationships, and finally a bibliography of seventy-one titles.

The second paper, by O. F. Cook, "Origin and Evolution of Angiosperms through Apospory," was published in the *Proceedings of the Washington Academy of Sciences* (vol. 9, pp. 159–178, July 31, 1907). In it the author first refers approvingly to the now widely accepted hypothesis as to the origin of gymnosperms through the ferns and the *Cycadofilices,* and then remarks that while evidence of such origin of the gymnosperms has increased rapidly in recent years, it "has not been accompanied by any equally convincing indications that the angiosperms shared the same pteridophytic ancestry." He, therefore, suggests that "morphologists may be willing to consider an alternative possibility, that the origin of the angiosperms should be sought more directly in some such primitive condition as the thallose liverworts, without the need of following back through the stages of development represented by the ferns and other vascular cryptogams." In brief, his suggestion is that "the female reproductive apparatus of the angiosperms is analogous to the fern-prothallia which are sometimes produced directly from the parent plant without the intervention of spores, that is, by aposporous growth from cells of the parent fronds."

The author then develops the theory that angiosperms have descended from an *Anthoceros*-like type. He holds that *Anthoceros* is not representative of ancestral pteridophytes, a contention which appears to us to be quite unnecessary, even from his own standpoint, since it is evident that pteridophytes and angiosperms have much in common. He suggests that were the capsule of *Anthoceros* to become perennial, and "produce prothallia instead of spores" the transition to the higher plants would be accomplished.

The paper is quite markedly philosophical, and while one may not be able to accept its conclusions, every botanist will find it profitable reading.

THE STUDY OF DIATOMS

THE "Report on the Diatoms of the Albatross Voyages in the Pacific Ocean, 1888–1904," by Albert Mann, published as one of the Contributions from the United States National Herbarium (vol. 10, part 5) is a notable addition to our knowledge of this group of plants. In the introductory pages the author describes the methods of work, and points out the importance of a fuller study of these plants than has yet been given them by our government officials. The generic and specific names accord with "the rules now generally prevailing in botanical nomenclature," necessitating in some instances "the substitution of obscure and inappropriate names for those universally known and recorded among living diatomists," which the author "feels to be a grave misfortune." The "Annotated Catalogue" which occupies 160 pages, includes three hundred species, of which forty-three are here described for the first time. The author has not found it necessary to establish any new genera, and this fact taken with the very moderate number of new species, shows him to be conservative in his treatment of the group. It is interesting to note that of the species, 169 belong to the subfamily *Centricae*, while 131 belong to the *Pennatae*. The large genera are *Coscinodiscus*, with 34 species; *Tripodiscus*, 13; *Biddulphia*, 30; and *Navicula*, 54. A most useful bibliography (the work of P. L. Ricker) including about four hundred titles, and eleven full-page plates, including 56 figures (mostly of new species) complete this very interesting and valuable paper.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

MEDALS FOR RESEARCH IN TROPICAL MEDICINE

THE Mary Kingsley medal, instituted by the Liverpool School of Tropical Medicine to commemorate Miss Mary Kingsley, the African traveler, who died in 1900, has been presented to the following for distinction in work of special research into tropical medicine:

1. Colonel David Bruce, F.R.S., C.B., Royal Army Medical Corps, who in 1887 discovered the cause of Malta fever, and proved that that malady was produced by the milk of infected goats.

2. Professor Dr. Robert Koch, Nobel Laureate, who ascertained the cause of cholera, and who has contributed much to the knowledge of tropical diseases, especially the discovery of the frequency of malarial infection in children.

3. Dr. A. Laveran, Pasteur Institute, Paris, and D.Sc., University of Liverpool, who in 1880 made the great discovery that malarial fever is caused by parasites in blood.

4. Sir Patrick Manson, F.R.S., K.C.M.G., London School of Tropical Medicine, who in 1878 discovered that one of the parasites of man belonging to the group of *Filaria* is carried by a kind of mosquito.

5. Dr. Basile Danilswsky, professor of physiology, University of Kharkoff, who discovered numerous parasites of blood in a large number of animals shortly after Laveran's discovery was made.

6. Dr. Charles Finlay, chief sanitary officer of Cuba, who in 1880 originated the theory that yellow fever is carried by mosquitoes.

7. Dr. Camirlo Golgi, professor of pathology, University of Pavia, who in 1887 made a complete study of the life cycle of parasites of malaria.

8. Colonel W. C. Gorgas, United States Army, who as chief sanitary officer of Havana gave practical effect in 1902 to the discoveries of Finlay and of the American commission in connection with yellow fever, and succeeded in banishing the disease from the city.

9. Waldemar Mordecai W. Haffkine, C.I.E., who in 1893 discovered a method of inoculation beneficially used in India.

10. Dr. Arthur Loos, professor of parasitology, School of Medicine, Cairo, for work in connection with parasitology.

11. Dr. Theobald Smith, professor of comparative pathology, Harvard University, who in 1893 discovered a new kind of blood parasite in the so-called Texas cattle fever.

SCIENTIFIC NOTES AND NEWS

Dr. Elwood Mead, chief of irrigation investigation of the U. S. Department of Agriculture and professor of institutions and practise of irrigation in the University of California, has accepted the office of chief of irrigation investigations for Australia. The salary of this position as reported is $15,000.

The Belgian Academy of Sciences has elected as foreign members Professor Svante Arrhenius, director of the division of physical chemistry of the Nobel Institute of the Swedish Academy of Sciences at Stockholm; M. E. J. A. Gautier, professor of organic chemistry and mineralogy in the faculty of medicine of the University of Paris, and Dr. Otto Wallach, professor of chemistry at Göttingen.

Dr. Albert Shaw, editor of the *Review of Reviews,* is president, and Mr. Ambrose Swasey, of the optical firm of Warner and Swasey, vice-president, of the jury of awards, now in session at the Jamestown exposition.

Professor J. Arthur Thomson, regius professor of natural history in the University of Aberdeen, will give seven lectures at Lake Forest College from September 24 to October 3. The Bross lectures are as follows: "The Wonder of the World," "The Order and Progress of Nature," "The Method of Animate Evolution," "Man's Place in Nature," and "The Spirit of Nature." There are two popular lectures, one on "The Biology of the Seasons," and one on "Some Wonders of Bird Life in Great Britain." The Bross fund was given to the trustees of Lake Forest University in 1879 by the late William Bross, of Chicago. According to the agreement, the sum of forty thousand dollars, the income of which was to accumulate in perpetuity for successive periods of ten years, the accumulations of one decade to be spent in the following decade, for the purpose of stimulating the best books or treatises "on the connection, relation and mutual bearing of any practical science, the history of our race, or the facts in any department of knowledge, with and upon the Christian Religion."

The president of the British local government board has authorized the following researches under the grant voted by parliament in aid of scientific investigation concerning the causes and processes of disease: (1) Further study of Dr. Sidney Martin, F.R.S., of the chemical products of pathogenic bacteria. (2) Bacteriological investigation by Dr. F. W. Andrewes of the air of sewers and drains. (3) Observation by Dr. W. G. Savage of the bacteriology of "garget" and maladies of the udder or teats of milch cows, and of possible relation of sore throat in the human subject to pathological conditions of the udder and teats of these animals. Also investigation by him of paratyhoid fever and its microbic cause. (4) Joint investigation by Drs. M. H. Gordon and T. J. Horder of the life processes of the meningococcus, with a view to means of combating cerebro-spinal fever.

Mr. H. G. Ferguson (Harvard '04) has been appointed assistant geologist in the Bureau of Science, Manila.

Mr. Sapir, recently appointed research assistant in the department of anthropology at the University of California, has this week returned from a two-months' trip to Shasta County for study of the Yana Indians and investigation of their language. He has brought back valuable information as to the structure of their language, which he is now about to prepare with a view to publishing.

Captain Isachen, commander of the Norwegian Arctic expedition, who returned to Christiania, on September 19, from Spitzbergen, says that on September 3 he found a letter, dated August 2, from William Bruce, the arctic explorer, for whose safety fear has been entertained, declaring that Mr. Bruce intended to journey northward instead of returning to his headquarters the next day, as he had planned.

Mr. William Wright, of Dayton, O., and his associate in negotiating the sale of the Wright Brothers' aeroplane to Germany, arrived at Berlin on September 16 and has been sympathetically received by the chiefs of the military balloon division of the army.

PROFESSOR WILBUR OLIN ATWATER, since 1873 professor of chemistry at Wesleyan University, died, on September 22, aged fifty-three years.

DR. GEORGE WASHINGTON PLYMPTON, professor of physics and engineering in the Brooklyn Polytechnic Institute since 1863, died, on September 11, at the age of eighty years.

DR. ELMER R. REYNOLDS, examiner of pensions under the government, known as an author and for writings on archeology, died in Washington, on September 18, at the age of sixty-one years.

MR. TIMOTHY HOLMES, an eminent British surgeon and anatomist, has died at an advanced age. He graduated from Cambridge University in 1847.

DR. FREIDRICH VOGEL, docent in applied mathematics and electrical engineering at the Technical Institute at Berlin, died on August 28.

AT the recent Los Angeles meeting of the National Educational Association three new departments were added, increasing the number to twenty-one, viz., department of technical education (authorized at the Asbury Park meeting); department of rural school and industrial education; department of educational committees of women's clubs. The board of directors authorized the appointment of seven committees of investigation, and made an appropriation of $500 for the expenses of each committee, viz., on the Culture Element in Education; on a System of Teaching Morals in Public Schools; on Industrial Education in Rural Schools; on Shortage of Teachers; on Provisions in Public Schools for Exceptional Children; on a National University; on Courses in Manual Training for Elementary Schools.

AT the recent meeting of the Anti-alcoholic Congress at Stockholm the physicians present formed an international society, the next meeting of which will be held in London in 1908. The subject of alcoholism also received much attention at the tenth Congress of Polish Naturalists and Physicians, recently held in Lvov, Galicia.

ACCORDING to Mr. A. T. Coons in a chapter in "The Mineral Resources of the United States," about to be issued by the U. S. Geological Survey, more salt was produced in the United States in 1906 than in any previous year, and the value of the product was greater than in any year since 1890. The quantity was 3,944,133 short tons, or 28,172,380 barrels, valued at $6,658,350, a gain of 308,876 tons, or 2,206,588 barrels, over the production in 1905. This increase in production was accompanied by a slight increase in price, from $1.68 to $1.69 per ton—not sufficient, according to some producers, to offset the increased cost of labor and supplies. In 1906, as in 1905, a large part of the output of salt was used in chemical works, as brine, without concentration into salt. The quantity of dry salt reported in 1906 was 2,603,818 short tons, or 18,598,700 barrels, valued at $6,179,666, an average value of $2.37 per ton or 33.226 cents per barrel. The corresponding figures for 1905 were 2,533,467 short tons, or 18,096,191 barrels, valued at $5,702,425, an average value of $2.25 per ton, or 31.512 cents per barrel. These figures show an increase for 1906 in the reported production of dry salt of 502,509 barrels, or 70,351 short tons in quantity; of $477,241 in value; and 1.714 cents per barrel, or 12 cents per short ton, in average price. New York leads in value of output, closely followed by Michigan. The output of Michigan, however, is considerably greater than that of New York. The average net price per barrel in New York in 1906 was 23.4 cents; in Michigan, 20.3 cents. Ohio ranks next, followed by Kansas. In 1905 Kansas exceeded Ohio in value of output; each shows an increase for 1906. California, Texas and Utah show an increase, and Louisiana and West Virginia a decrease, in value of output. Michigan and New York combined contributed more than two thirds (67.14 per cent.) of the total production of the United States. Of the five leading salt-producing states during 1906, Michigan produced 9,936,802 barrels (35.27 per cent.), New York 8,978,630 barrels (31.87 per

cent.), Ohio, 3,236,758 barrels (11.49 per cent.), Kansas 2,198,837 barrels (7.8 per cent.), and Louisiana 1,179,528 barrels (4.19 per cent.). These five states contributed 90.62 per cent. of the total quantity of salt produced in the country during the year.

UNIVERSITY AND EDUCATIONAL NEWS

It is announced that the Morley Chemical Laboratory of Western Reserve University, named in honor of Dr. Edward W. Morley, emeritus professor of chemistry, will be built during the present year.

The College of the City of New York begins its fifty-first year in its magnificent new buildings on St. Nicholas Heights.

Work on the new medical and science buildings of McGill University, to replace those destroyed by fire, is progressing rapidly. The new medical building will cost at least $500,000.

It is proposed to erect a new building for the medical department of Tulane University, New Orleans. The building will be on the university campus, at a cost of $150,000.

Dr. Joseph Marshall, of the University of California, succeeds Dr. William H. Carmalt, as professor of surgery in Yale University.

Dr. A. M. Reese, of Syracuse University, has been appointed professor of zoology at the University of West Virginia, Morgantown, W. Va.

Julian C. Smallwood, M.E. (Columbia University '03), has been appointed professor in charge of the department of mechanical engineering at George Washington University.

Mr. Murray Arnold Hines, Ph.D. (Harvard), of the Mallinckrodt Chemical Works of St. Louis, has been appointed assistant professor of chemistry in Northwestern University.

Professor J. C. Shedd, for the past seven years professor of physics at Colorado College, Colorado Springs, has been elected dean of the College of Letters and Science of Westminster University, Denver, Colorado. Dr. Shedd will also hold the chair of physics. Dr. John Inglis, of Pueblo, Colo., has been elected to the chair of physiological psychology and physiology and hygiene. Dr. Inglis was for three years director of the Presbyterian Hospital at Pekin, China, and has studied abroad in the Hospitals of London and Berlin.

The following additional appointments have been made in the department of chemistry, College of the City of New York: *Tutors*—Robert W. Curtis, Ph.D., Yale, 1904; L. J. Cohen, Ph.D., Columbia, 1907; H. B. Griffin, A.B., Bowdoin, 1904. *Assistant Tutor*—B. F. Feinberg, B. S., College of the City of New York, 1907. Tutor Prager has been granted a year's leave of absence to complete his work for the degree of doctor of philosophy at the Clark University.

The following promotions and appointments, some of which have already been announced, have been made at Lehigh University for the coming year: Professor J. F. Klein, dean of the faculty and superintendent of heat and light; P. B. deSchweinitz, professor of machine design in the department of mechanical engineering; Robert C. H. Heck, professor of experimental engineering in the department of mechanical engineering; Frank P. McKibben, professor of civil engineering, in charge of the department; Winter L. Wilson, professor of railroad engineering in the department of civil engineering; W. B. Schober, professor of chemistry; Dr. Myron J. Luch, assistant professor of English; Dr. Benjamin L. Miller, professor of geology; Walter S. Landis, assistant professor of mineralogy and metallurgy; Dr. Walter W. Davis, professor of physical education; Dr. Percy L. Hughes, assistant professor of philosophy and psychology; N. M. Emery, assistant to the president; Joseph B. Reynolds, instructor in mathematics; Dr. George E. Stebbins, J. A. Veasey and Rollin L. Charles, instructors in physics; Edward S. Foster, instructor in electrical engineering; Dr. Wm. L. Berkeley, instructor in industrial chemistry and qualitative analysis; Dunlap J. McAdam, Jr., assistant in chemistry; T. A. W. Mawhinney, assistant in German; R. J. Gilmore, assistant in German.